MacΣqn

The Equation Processor

Version 2.1.3

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MacΣqn

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MacΣqn is a Macintosh desk accessory which provides an environment for writing technical equations for inclusion into documents written with Macintosh™ word processing programs. This manual describes the use and operation of MacΣqn. In it you will find information on:

- how to install MacΣqn into the menu
- how to start MacΣqn
- how to use MacΣqn
- what the capabilities of MacΣqn are.

In the appendix you will find a summary of command key equivalents, general information on how MacΣqn operates, and specific instructions on using Font/DA Mover to install desk accessories into the menu and fonts into the system.

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Installation and Activation

On the MacΣqn distribution disk you will find the desk accessory file MacΣqnDA, an application called *Make Palette*, and a *Fonts Folder* containing the LaserWriter® screen fonts and Font/DA Mover. Of course, the first thing you should do is make a backup copy of the distribution disk. MacΣqn is not copy-protected. Use *Font/DA Mover* to copy the desk accessory MacΣqn into the system file on the disk you wish to work with. If you are unfamiliar with using *Font/DA Mover*, instructions can be found in the Appendix to this manual. Do not use a version of *Font/DA Mover* earlier than the one on the distribution disk.

MacΣqn can use any fonts available in your operating system, but MacΣqn provides simple keyboard access to the LaserWriter fonts: Helvetica®, Times®, Courier, and Σψμβολ (Symbol). Copies of these fonts can be found in the *Fonts Folder* on the distribution disk. Use the program Font/DA Mover to install the desired fonts into your operating system. Symbol font is essential as it is used to generate the Σ, Π, and ∫ symbols as well as the Greek characters commonly used in equations. We recommend you install at least 9 pt., 12 pt., and 24 pt. sizes for equations to be easily readable on screen. If you plan to use the Imagewriter heavily for hardcopy we recommend you also install 18 pt. fonts in your system.

Once you have installed the fonts and the desk accessory, you can activate MacΣqn by selecting MacΣqn from the desk accessory menu (the menu). A window entitled "**MacΣqn**" will appear and a menu entitled "**Σqn**" will be inserted into the menu bar. A copyright notice will appear in the window but will disappear on the first keystroke.

Quick Tutorial

In this section we shall go step-by-step through the creation of this simple equation from information theory, the channel capacity:

$$C = \int_{-\infty}^{\infty} \log\left[1 + \frac{W_S(u)}{W_N(u)}\right] du .$$

- Activate MacΣqn by selecting it from the menu.
- Type 'C = ' for the first sequence
- Click on the [∫] icon in the command palette.

  An integral symbol will be drawn on the screen. The small arrow cursor will be positioned at the bottom of the integral. The **Stack** status line indicator will read **Integral Lower 2**, meaning you are currently typing the lower limit of an integral. Don't worry about what the 2 stands for at this time. Notice the point size has automatically dropped from 12 pt. to 9 pt. for the limits.

- Type '-∞' (∞ is OPTION-5 in Times) and press <ENTER> .

  Notice the lower limit is automatically centered on the integral symbol and the cursor is positioned for typing the upper limit. The **Stack** indicator should now read **Integral Upper 1**.

  The <ENTER> key is the most important key in MacΣqn. You press <ENTER> whenever you want to tell MacΣqn you are finished typing characters for a given part of a command such as the upper or lower limit of an integral or sum.

- Type '∞' and press <ENTER>.

  Stack now indicates **0** and the insertion point is positioned back at the main character baseline ready for further input. Also, the point size has automatically return to 12 pt. On screen, the equation looks like: $C = \int_{-\infty}^{\infty}$

- Type 'log '.

  You are now ready to type the text enclosed by large square brackets. You should use the uncentered form of the **Group** command so the group will not be automatically vertically centered. A **Group** is a block of text

enclosed by special characters such as '|' or '{}'. For further details, see the description of **Group's** in the *Using MacΣqn* section of this manual.

- Click on the toggle icon [⋮].

  Clicking on this icon tells MacΣqn that Groups are not to be vertically centered.

- Click on the [..] icon.

  This command activates a group that will be enclosed by square brackets (but will not be vertically centered). **Stack** will read **Group [...] 1**.

- Type '1 + '.

  You are now ready to begin the fraction. On screen, the equation now looks like: $C = \int_{-\infty}^{\infty} \log [1 +$

- Click on the fraction icon [a/b].

  Stack will read **Fraction Denom 3**. The cursor will be positioned ready to accept denominator input. Now press 'W'. At this point you want to type the subscript 'N'. The equation now looks like:

  $$C = \int_{-\infty}^{\infty} \log [1 + W$$

- Click on the [x] icon to activate super/subscripting.

  Stack will read **SuperSub Subscript 5** indicating you are currently entering the subscript.

- Type 'N' followed by <ENTER>.

  This will position the 'N' as a subscript to 'W'. Notice that 'N' is in 9 pt. After pressing <ENTER>, the cursor will be positioned ready for superscript input. **Stack** will read **SuperSub Superscript 4**.

- Press <ENTER>.

  Typing <ENTER> with no other characters tells MacΣqn there is no superscript on the 'W'. The cursor will be returned to the baseline of the 'W' ready to accept more characters of the denominator. **Stack** will read **Fraction Denom 3**.

- Type '(u)' followed by <ENTER>.

At this point you are finished with the denominator. **Stack** will read **Fraction Numer 2**. The equation now looks like: $C = \int_{\blacksquare}^{\blacksquare} \log [1 + W_N(u)$

- Type the numerator '$W_S(u)$' the same as you did the denominator.

Don't forget to subscript the 'S' and to press <ENTER> when you finish with the numerator. **Stack** will read **Group [...] 1**. Notice that a fraction line was drawn and the numerator and denominator were horizontally centered automatically: $C = \int_{\blacksquare}^{\blacksquare} \log [1 + \frac{W_S(u)}{W_N(u)}$

- Press one more <ENTER>.

This terminates the group request. **Stack** will read **0**. Notice the text is automatically enclosed by large square brackets.

- Type ' du'.

You have now created your first equation with MacΣqn. To include the equation in a document, simply go to the **Edit** menu and select **Copy** (or press ⌘-'c'). Now switch to the word processor (or **Scrapbook**, for example) and select **Paste** to paste the equation into the document.

Using MacΣqn

MacΣqn treats an equation as a sequence of constructs which are stored on a 'stack'. A stack can be visualized by thinking of a stack of coins. Each time you 'push' a new coin onto the top of the stack, it becomes the top (or current) coin. If you remove a coin from the stack, you remove (or pop) the top coin. Each time you request one of the mathematical functions supported by MacΣqn, a certain number of levels associated with that function are pushed onto the stack. For example, there are two levels pushed onto the stack for a summation: the upper limit and the lower limit. **To pop a level off of the stack you press the <ENTER> key.** This also causes any required formatting to be performed (such as the centering of limits on the summation character.) Status indicators in the **MacΣqn** window let you follow the construction of the equation. Font information is presented as well as the current command, the top stack level, and the depth of the stack.

MacΣqn automatically reduces and enlarges font sizes as is necessary to comply with typographical conventions, though you can easily over-ride the automatic controls.

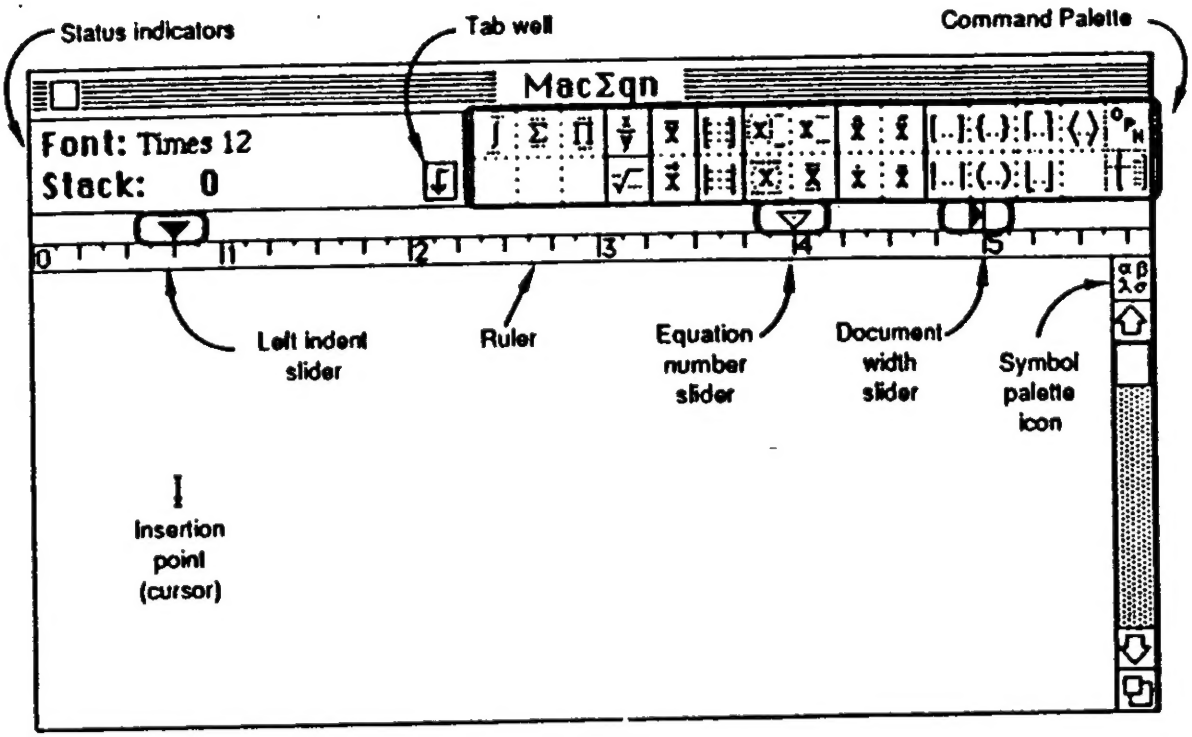
Interaction with MacΣqn can occur in several ways:

- Typing characters into the equation from the keyboard
- Typing command-key equivalents
- Selecting characters from a symbol palette
- Clicking on the command palette to request commands
- Selecting from the **Σqn** menu
- Dragging ruler sliders

The following sections describe in detail how you can interact with MacΣqn to create your technical equations.

The MacΣqn Window

The following diagram is an annotated picture of the MacΣqn window. The MacΣqn window can be resized with the grow box and repositioned by dragging the title bar. MacΣqn will remember the size and location of its window until you next change it.

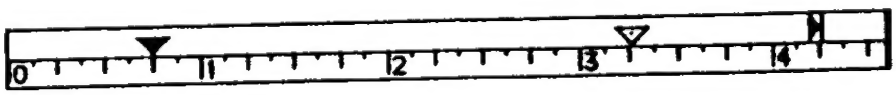


Ruler

Just below the command palette and the status indicators is a graphical ruler marking one-eighth inch intervals across MacΣqn window. This ruler has two functions:

- to provide visual reference
- to provide the scale for the sliding indicators ▼, ▽, and ▌.

The ▌ indicator is used to tell MacΣqn the width of the document you are going to paste the equation into (the right margin minus the left margin). The ▽ indicator is used to specify a special tab for equation numbers, and the ▼ indicator is used to specify a left-indent for an equation if auto-centering is not desired. The scale of the ruler can be either English (inches) or metric. To set the scale to metric, see the section describing the **Preferences...** menu selection.



MacΣqn has the ability to automatically center an equation when you copy it to the clipboard. To do this, MacΣqn needs to know the width of the column you are planning to paste the equation into. This value is set by positioning

the ⏽ indicator at the appropriate ruler value. For example, if you were using Microsoft Word with the right margin set to 6 inches and the left margin set to 0 inches (as is the case in this document), you would set the ⏽ indicator to 6 - 0 = 6 inches. Technically, the ⏽ indicator determines the width of the PICTure copied to the clipboard. For auto-centering, the equation is shifted such that it is centered in the picture. To set this value, simply point at the ⏽ character and press the mouse button down. As long as the button is pressed you will be able to slide the indicator back and forth. Release the button at the position desired.

The ▽ indicates the position of the equation-number tab. Typing ⌘-TAB will cause the MacΣqn cursor to shift to the horizontal position marked by the indicator. Equation numbers will always line up if you use the equation-number tab. Equations numbers are terminated by a RETURN. You can set the position of the ▽ indicator in the same fashion as the ⏽ indicator. However, you cannot set the equation-number tab to the right of the ⏽ indicator. MacΣqn will normally left-justify equation numbers, meaning the left-most character is positioned at the equation-number tab. You may instead wish to have equation numbers right-justified, that is, have the right-most character of the equation number lined up with the equation-number tab. You can select whether you want equation numbers to be right or left-justified by clicking the appropriate button in the dialog box presented by selecting **Preferences...** from the **Σqn** menu.

You may also wish to generate equations that are left-indented instead of centered. This can be done using ⌘-OPTION-'**c**'. The ▼ indicator specifies the indent distance used. You control this indent indicator in exactly the same way as the ⏽ and ▽ indicators.

The values of the ▼, ▽, and ⏽ indicators are retained until you next change them.

Tab Well

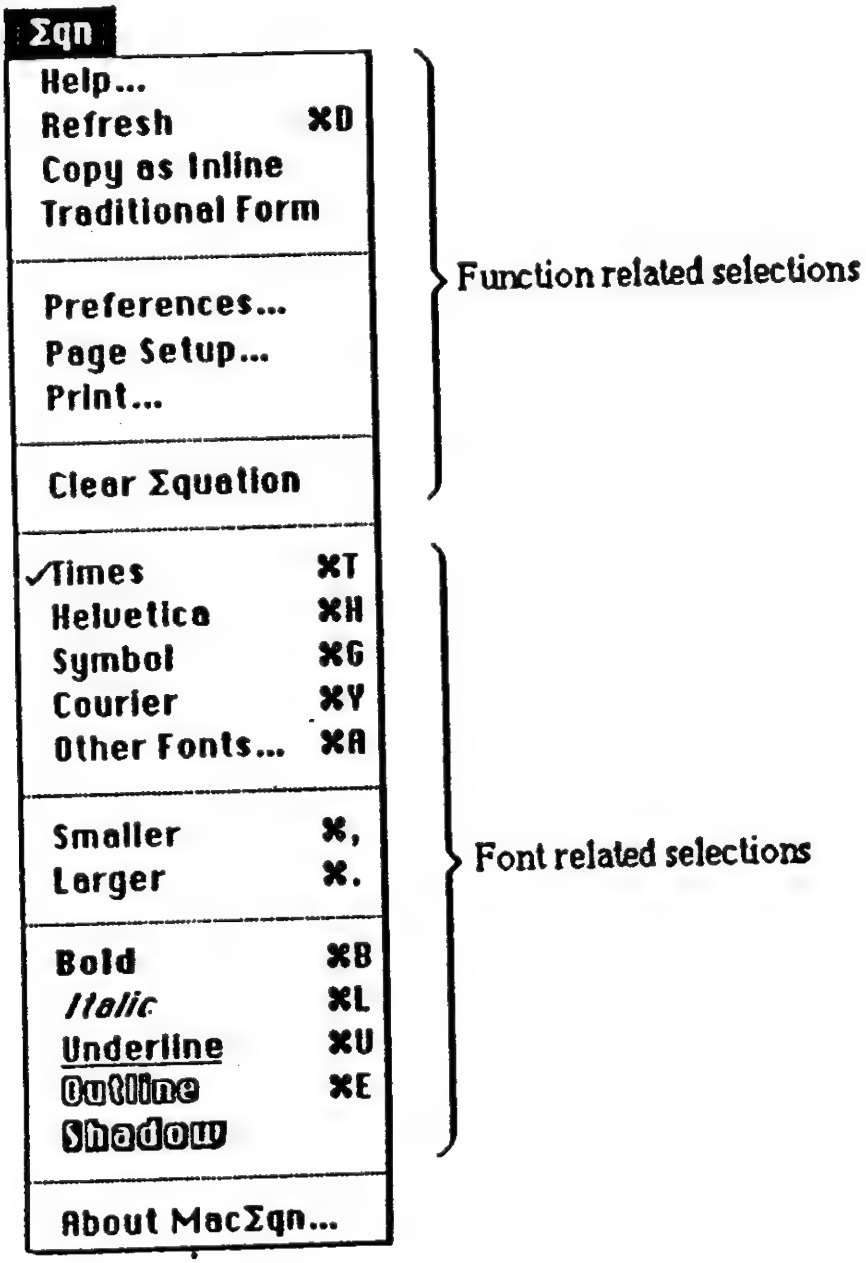
MacΣqn supports up to 10 programmable tabs. A tab well ⍗ is located to the left of the command palette. To use this, click the mouse in the tab well and drag a tab ↧ to the location desired on the ruler (in the same band as the sliders ▼, ▽, and ⏽). To remove a tab, drag it away from the ruler and release the mouse button. Each time you press a tab key the cursor will move

to the next programmed tab, or to a default tab position if no programmed tabs lie to the right of the cursor. Programmed tabs are remembered each time you invoke MacΣqn.

Menu

The **Σqn** menu consists of several items organized into two categories:

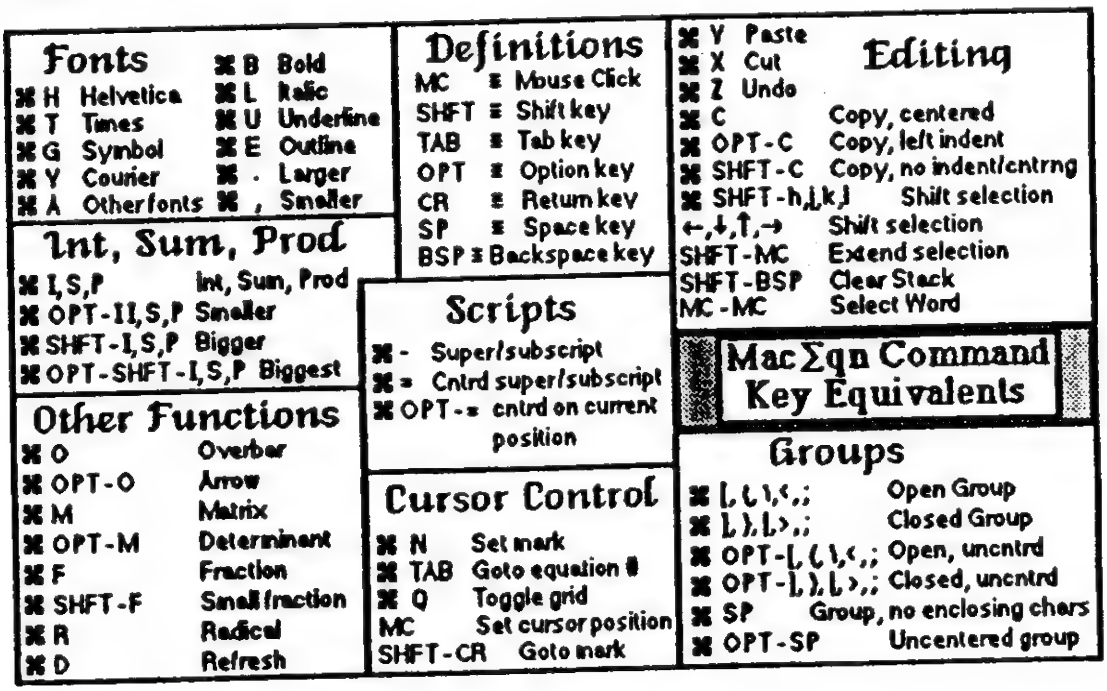
- *Function*-related selections
- *Font*-related selections

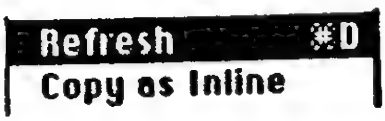


Function Group

Help...

This menu selection causes a dialog box to appear which lists all of the command-key equivalents MacΣqn supports. Clicking within the box causes it to go away.





Refresh ⌘D

Refresh causes the screen to erase and redraw. Occasionally the cursor 'walks' over displayed text and whites out some portions of the equation. Selecting **Refresh** will refresh the screen, cleaning up any distorted areas of the equation.

The command-key equivalent for **Refresh** is ⌘-'d'.

Copy as Inline ⌘ SHFT C

Most MacΣqn users desire to place simple equations in a line of text at one time or another. MacΣqn has always supported this, if the word processor allowed it. However, the standard **Copy** (⌘-'c') command creates an equation with a width indicated by the ⏵ slider. For inline equations, you want a picture no wider than the equation itself. Use the **Copy as Inline** menu selection to copy equations suitable for inline insertion.

The command-key equivalent for **Copy as Inline** is ⌘-SHFT-'c'.

Traditional Form

In many texts and journals equations are formatted such that variables are italicized. Creating such an equation can be difficult on the Macintosh since italicized characters are often difficult to read on the screen. With the **Traditional Form** menu command, you create the equation with easy-to-read un-italicized characters. Then, you select this entry from the menu and MacΣqn will stream through the equation and italicize all variables of the equation. Digits and special symbols such as integral, sum, and product are not italicized. Also, key words such as cos, sin, log, ... are not italicized. Once you have selected **Traditional Form**, the menu entry changes to **Standard Form**. Selecting this new entry causes the removal of the italics attribute from all characters of the equation.

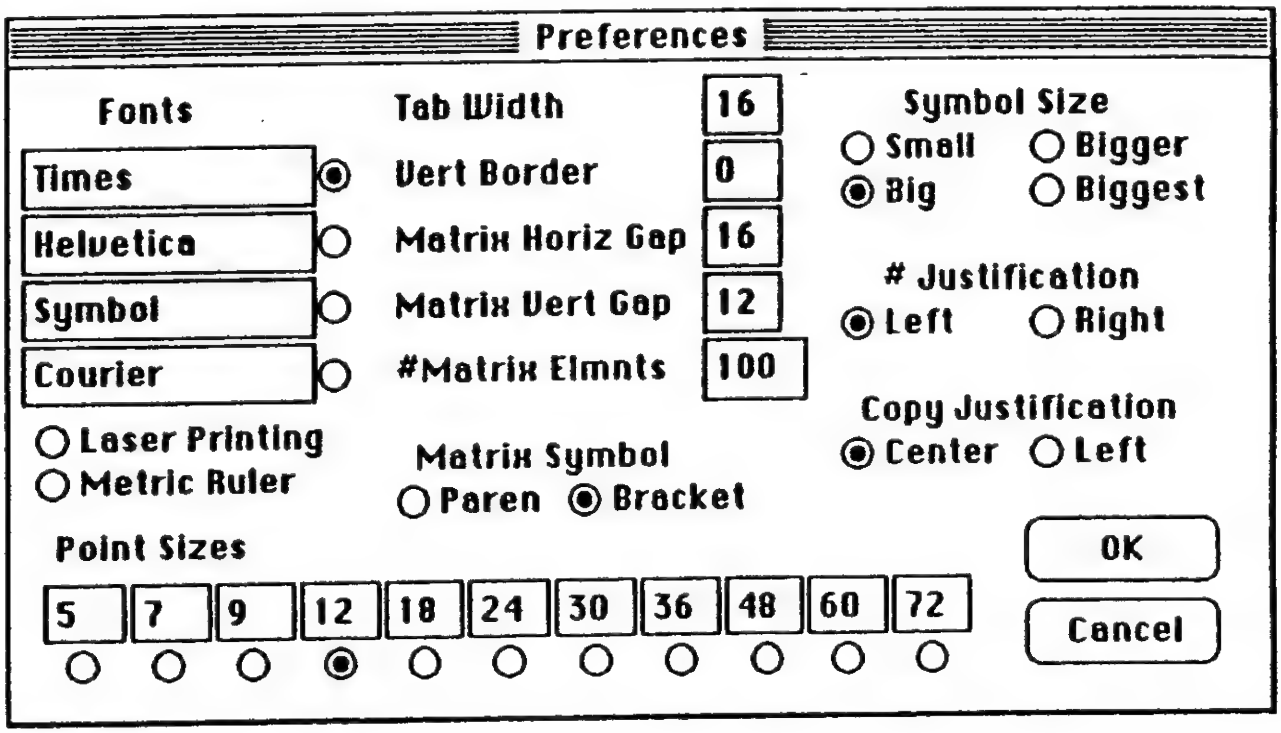
Before selecting **Traditional Form**: $E(f_x|x') = \int_0^{x'} t(x) \exp\{2\pi f_x x\}\, dx$

After selecting **Traditional Form**: $E(f_x|x') = \int_0^{x'} t(x) \exp\{2\pi f_x x\}\, dx$

Note to the guru: the list of character sequences that are *not* italicized when **Traditional Form** is selected is stored in a STR# resource. Using a resource editor such as ResEdit, you can add (up to 32 strings) or delete to this list.

Preferences...

Many quantities in MacΣqn can be customized to suit the users needs. When you select **Preferences...** from the **Σqn** menu, the dialog box pictured below is presented.



To change:	*Do:*
• The four fonts accessible with keyboard equivalents.	Type font names into the four positions available..
• The startup default font	Click the button to the right of the desired font name.
• The point sizes supported by MacΣqn	Change numbers in the 11 boxes.
• The startup default font size	Click the button below desired size.
• The width of a TAB character	Change number in the **Tab Width** box.
• The separation between adjacent rows and columns of a matrix.	Change the **Matrix Horiz Gap** and the **Matrix Vert Gap** boxes.
• The maximum number of elements in a matrix.	Change **#Matrix Elmnts** box.

• Whether a matrix is enclosed by square brackets or parentheses.	Click appropriate **Matrix Symbol** button.
• Whether equation numbers will be left or right justified	Click appropriate **# Justification** button.
• Whether the ruler will be in English or metric units.	Click **Metric Ruler** button for metric units.
• Whether graphics symbols such as roots, angle brackets, fraction lines and overbars will be printed as hairlines on the LaserWriter.	Click **Laser Printing** for hairline printing.
• Whether ⌘-'c' copies a centered equation to the clipboard or a left-indented equation.	Click appropriate **Copy Justification** button.
• Whether ⌘-'i' ('s',or 'p') generates an integral (sum, or product) that is 1,2,3, or 4 allowable sizes larger than the incoming font size.	Under **Symbol Size**, click **Small** for 1 allowable size larger **Big** for 2 allowable sizes larger **Bigger** for 3 allowable sizes larger **Biggest** for 4 allowable sizes larger
• What, if any, vertical border is added to the top and bottom of the copied equation.	Change number in the **Vert Border** box

Remember, MacΣqn was designed to use the four LaserWriter fonts; other fonts may not produce acceptable results.

Page Setup...
Print...

These menu entries provide support for standard printing on Macintosh printers. The **Page Setup...** command invokes the standard Page Setup... dialog box. The **Print...** command invokes the standard print dialog. Be sure to select **Chooser** from the menu prior to printing if you have not previously specified a destination printer.

Clear Equation

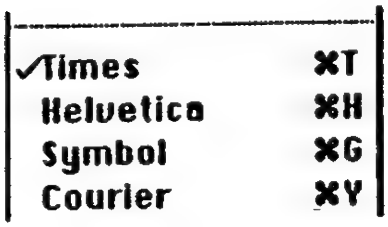
Clear Σquation performs the same function as selecting **Clear** from the **Edit** menu, i.e. the equation is erased without saving it to the clipboard. Some applications do not support the **Clear** menu entry, so we have provided **Clear Σquation** as a quick way to clear the MacΣqn window in preparation of generating a new equation.

About MacΣqn...

Selecting **About MacΣqn...** will display a dialog box containing the current version of the MacΣqn and other typical information. A single click in this dialog will present an interesting bit of animation. A second click closes the box.

Font Group

Menu selections from the Font group change the current font, font size (either smaller or larger), or the face (style) of the displayed characters. The **Font** status line entry keeps the user notified of the current font and size. Current font face is indicated by the face of the font and size indicators.



Times ⌘T
Helvetica ⌘H
Symbol ⌘G
Courier ⌘Y

Though MacΣqn supports any font in the operating system, four fonts are directly accessible from the **Σqn** menu: Helvetica, Times, Σψμβολ (Symbol), and Courier. These fonts are also accessible through command-key equivalents. Selecting these menu entries will change the current font to the font selected. From that point on, all characters typed will be displayed in the selected font. These fonts were chosen because they are fully supported by the LaserWriter such that all point sizes chosen for equations will print at full LaserWriter resolution. If a font name is greyed in the **Σqn** menu then that particular font is not available, i.e., it has not been installed into the

operating system.

You can change these four fonts if you wish; however, MacΣqn was not designed for use with other fonts and results may not be satisfactory. For details, see the description of the menu command **Preferences...** .

Note: Symbol font is essential for normal operation of MacΣqn.

Other Fonts... ⌘A

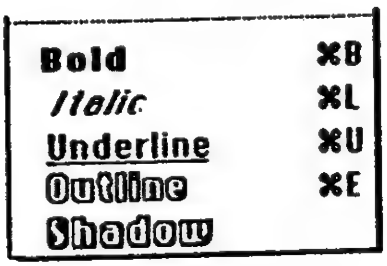
Selecting this menu entry will cause the **Σqn** menu to be replaced by a new menu called **ΣqnFonts**. This menu will list all fonts available in the operating system. You can set the current font to be any of these by selecting the appropriate name. Once you have made a selection, the **ΣqnFonts** menu will be replaced by the **Σqn** menu. Remember, MacΣqn was designed for use with the LaserWriter fonts. Other fonts may not produce satisfactory results.

Smaller ⌘,
Larger ⌘.

Selecting these entries will cause the current point size of the characters to change accordingly. The standard allowable point sizes include:

point sizes = { 5, 7, 9, 12, 18, 24, 30, 36, 48, 60, 72 }.

You can modify the allowable font sizes to suit your needs if necessary. Again, see the description of **Preferences...** for details.



Bold ⌘B
Italic ⌘L
Underline ⌘U
Outline ⌘E
Shadow

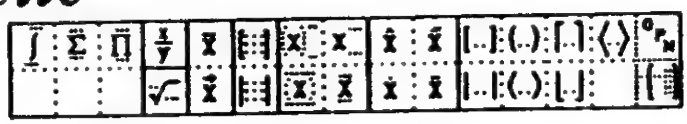
These menu items will change the current face of the characters. The user can have one or more selected at the same time. A menu selection will toggle the style such that the first time the item is selected the style is activated, the second time the item is selected the style is deactivated, the third time the style is activated, etc.

Symbol Palette

Clicking on this icon causes a symbol palette to appear in the MacΣqn Window. This palette is completely programmable by the user. See the Appendix for instructions on how to program the palette. A second icon selection hides the symbol palette.

You may use the palette by simply clicking on palette characters as desired. The characters will appear at the insertion point in the correct font and at the current size and face. The palette can accommodate 98 special characters. With this palette, you can have access to your favorite characters from special fonts. You do not have to remember what key combinations generate what characters; simply point and click.

Command Palette



The MacΣqn command palette provides access to MacΣqn's special formatting features. To invoke a command, click on the appropriate icon or type the command-key equivalent.

The Stack status line reports

- what command is currently being processed,
- the current level (lower limit or upper limit, etc.), and
- the current depth of stack.

For example, for a summation the Stack indicator would be 'Sum' followed by either 'Lower' or 'Upper', depending on whether the lower limit or the upper limit is currently being input, followed by a decimal number indicating how many levels have previously been pushed onto the stack. On startup, there will be no entries for Stack except a 0 (zero) indicating the stack is empty. The maximum depth of the stack is 15.

∫ Integral ⌘I
Σ Summation ⌘S
Π Product ⌘P
□□□ Programmable Limited Characters

To MacΣqn **Integrals**, **Summations**, and **Products** are similar constructs. Selecting one of these command palette icons causes the appropriate symbol to be drawn on the screen and pushes two levels onto the stack, a request for an upper limit followed by a request for a lower limit. The cursor is positioned for keyboard entry of the lower limit. Pressing the <ENTER> key will terminate the current level causing the lower limit to pop off the stack. The text of the lower limit will be centered appropriately and the cursor will be positioned ready for the upper limit. Typing a second <ENTER> causes the upper limit to terminate, center appropriately, and pop off the stack. The second <ENTER> completely terminates the icon selection.

The **Programmable Limited Characters** behave exactly the same as the sum, integral, and product except you have the ability to program what character gets limited. To program a character, activate the symbol palette by clicking on the [αβ/λφ] icon. Hold the OPTION-key down and press the mouse button down over top of the character you want to have limited. Drag the character into one of the three **Programmable Limited Characters** icons and release the button. A small version of the character will be drawn into the icon, with ellipses for limits. Once programmed, you can use the **Programmable Limited Characters** just as you would sum or integral or product. These icons can be reprogrammed by depositing another character from the symbol palette. The programmed characters are remembered until you next change them.

The command-key equivalent for **Integral** is ⌘-'I'. The command-key equivalent for **Summation** is ⌘-'s'. The command-key equivalent for **Product** is ⌘-'p'. There is no command-key equivalent for the **Programmable Limited Character**.

$$\int_{-}^{-} \qquad \sum_{k=1}^{32} \qquad \prod_{k=1}^{32}$$

In certain situations you may desire the symbol character to be drawn either larger or smaller than the size MacΣqn automatically draws it in. If the selection is made by command-key equivalent with the OPTION-key help down, the symbol will be drawn one allowable size larger than the current point size; if the SHIFT-key is held down, the symbol size will be three allowable sizes larger than the current size rather than two; and if both the OPTION-key and SHIFT-key are depressed, the symbol will be four allowable sizes larger. These different sizes are shown below.

Note: to get the ⌘-OPTION form of the integral, you must type the sequence twice consecutively.

Cmd-Option-I Cmd-I Cmd-Shift-I Cmd-Option-Shift-I

MacΣqn will automatically control the point size of the symbol and limits. Point sizes are determined by a simple algorithm. Symbol size is determined by increasing the current point size (usually the size of the last character typed before the palette selection) by two allowable point sizes. The limit sizes are one allowable size smaller than the current size. For example, if the current size was 12 point, the symbol would be drawn in 24 point and the limits would be in 9 point. Use the standard font size menu selections to override the size of the limits as desired.

Super/Subscript ⌘-
Centered Super/Subscript ⌘=

These commands allow you to position super- and subscripts on characters in your equations. **Super/Subscript** provides normal super- and subscripting while **Centered Super/Subscript** allows you to position sub- and superscripts centered horizontally in the middle of the last character. When **Super/Subscript** or **Centered Super/Subscript** is selected, two levels are pushed onto the stack: a superscript level followed by a subscript level. This allows both a superscript and a subscript to be formed on the same character. Press <ENTER> to terminate each level as described earlier. Default font sizes are determined by the algorithm described above.

The command-key equivalent for **Super/Subscript** is ⌘-'-'; the equivalent for **Centered Super/Subscript** is ⌘-'='.

Selecting **Centered Super/Subscript** by command-key equivalent with the OPTION-key pressed centers the script on the current cursor position rather than on the last character.

$$e^{-i2\pi(f_x x + f_y y)} \qquad \underset{x \neq y}{X}$$

Body Super/Subscript
Body Centered Super/Subscript

These commands are very similar to the above commands with the difference that **Body Super/Subscript** and **Body Centered Super/Subscript** position scripts relative to a block of characters while **Super/Subscript** and **Centered Super/Subscript** position scripts on the last character typed. When these commands are selected, three levels are pushed onto the stack: a superscript level followed by a subscript level followed by a body level. An example of using these icons is the function $\lim_{n\to\infty}$. To create this function, first select the **Body Super/Subscript** icon. Then, type the text 'lim' followed by <ENTER>. Next, type the expression 'n→∞' and press <ENTER>. There is no superscript, so terminate the entire construction with another <ENTER>. The text 'lim' is the *body*, and the subscript 'n→∞' is centered below the body.

$$\lim_{n\to\infty} \qquad \iint_{-\infty}^{\infty}$$

Hat
Tilde
Dot
Double Dot

Selection of these icons will cause a caret (or tilde, dot, double dot) to be positioned above the last character typed. A second icon selection will remove the caret.

Fraction ⌘F

Selection of the **Fraction** icon allows the construction of two-line fractional forms. Again, two levels are pushed onto the stack, but in this case they are a numerator followed by a denominator. The cursor is positioned for character input to the denominator. Pressing <ENTER> terminates the

denominator and positions the cursor for the numerator. Once the numerator is terminated, appropriate centering of both the numerator and the denominator is performed and the fraction line drawn.

The command-key equivalent for **Fraction** is ⌘-'f'.

$$1 + \cfrac{1 - \cfrac{1 - x}{1 + x}}{1 + \cfrac{1 - x}{1 + x}} \qquad \frac{\sum_{m=k_i}^{k_f} v^2 R_m}{\frac{R_1}{2} + \sum_{k=2}^{32} R_k}$$

If **Fraction** is selected by a ⌘-SHIFT-'f', there will be a font size reduction of one allowable size; otherwise no automatic reduction occurs. To create fractions of more than two lines, simply nest **Fraction** calls as required.

Occasionally, you may edit the numerator or denominator of a fraction and find the fraction line is left too short or too long. If you select the line (see ***Editing*** for details on selection), you can lengthen or shorten it by holding the command-key down and typing the left or right arrow key.

Radical ⌘R

Selection of **Radical** provides formatting of root functions, i.e., square root, cube root, etc. Two levels are pushed onto the stack, first the power then the function. The font size of the power is reduced but that of the function is not affected.

The command-key equivalent for **Radical** is ⌘-'r'.

$$1 + \sqrt[3]{1 + x^2} \qquad 1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + x^2}}}}$$

Occasionally, you may edit a root and find the radical symbol line is left too short or too long. If you select the radical (see ***Editing*** for details on selection), you can lengthen or shorten it by holding the command-key down and typing the left or right arrow key.

Over Bar ⌘0

Selecting **Over Bar** allows the use of over-bars in equations. Only one level is pushed onto the stack. After you have selected the icon, type the characters you wish the over-bar to cover, then press <ENTER>. When the level is terminated an over-bar will be drawn over all characters involved. Multiple overbars can be used by multiple menu selections.

The command-key equivalent for **Over Bar** is ⌘-'o'.

$$\overline{X-\overline{X}} \qquad \langle |X - \overline{\overline{X}}| \rangle$$

Occasionally, you may edit an over-bar and find the line is left too short or too long. If you select the line (see ***Editing*** for details on selection), you can lengthen or shorten it by holding the command-key down and typing the left or right arrow key.

Over Arrow ⌘ OPT O

Selecting **Over Arrow** allows the use of over-arrows in equations. Only one level is pushed onto the stack. When the level is terminated an arrow will be drawn over all characters involved. Multiple arrows can be used by multiple selections.

The command-key equivalent for **Over Arrow** is ⌘-OPTION-'o'.

$$\vec{r}_1 \bullet \vec{r}_2$$

You can adjust the length of the arrow in the same fashion as the over-bar.

Matrix ⌘M

Determinant ⌘ OPT M

Selecting the **Matrix** icon enables you to create formatted 2-dimensional matrices with up to 100 elements (say, a 10 by 10 matrix). A single command is pushed onto the stack. You then type each element of the matrix using TAB to separate columns and RETURN to separate rows. Use normal MacΣqn abilities to format each element. Press the <ENTER> key when you have finished all elements of the matrix. After you type <ENTER>, MacΣqn will automatically align all elements.

The command-key equivalent for **Matrix** is ⌘-'m'.

In exactly the same fashion, selecting the **Determinant** icon allows you to create matrix determinants.

The command-key equivalent for **Determinant** is ⌘-OPTION-'m'.

MacΣqn determines the number of elements in each row from the first line. Be sure to type the same number of elements in each row; unpredictable results may occur if you do not. You may use multiple TABs or RETURNs to separate elements as you are typing them if it makes it easier to see what you are doing. MacΣqn treats a sequence of TABs and RETURNs as a single one. In formatting, MacΣqn defines the width of each column as the maximum width of elements in that column. The height of each row is calculated similarly. Each element is centered in the column allocated for it. Each element shares a common baseline with all other elements in it row. If you want each matrix element to be vertically centered in the row (i.e. not share a common baseline), use the command-key equivalent ⌘-SHFT-'m', Below is an example of creating a matrix; the left sequence is the matrix just prior to typing <ENTER>, and the right sequence is the final matrix after typing <ENTER>.

$$\begin{bmatrix} 1 & e^{-i2\pi f_x x} \\ e^{+i2\pi f_x x} & 1 \end{bmatrix} \qquad \begin{bmatrix} 1 & e^{-i2\pi f_x x} \\ e^{+i2\pi f_x x} & 1 \end{bmatrix}$$

Matrix elements are separated vertically and horizontally by distances determined from MacΣqn resource files. You can control these spacings with the dialog box presented by selecting **Preferences...** from the menu.

Groups

Programmable Group

A **Group** is a collection of characters with a rectangular bounding area, usually enclosed by large brackets, braces, or parentheses. A **Group** is a more general construct than a matrix and can be used anytime you wish to enclose a block of characters within brackets. Examples of groups are:

$$(abc)\begin{pmatrix} abc \\ def \\ ghk \end{pmatrix} \qquad f(x) = \begin{cases} -1, & x<0 \\ 0, & x=0 \\ +1, & x>0 \end{cases}$$

The groups on the left are called 'closed' groups because they are enclosed on both the left and right sides by a large character; the group on the right is

called an 'open' group as it has a large character only on the left side. Supported enclosing characters are:

square bracket - [ ]	parenthesis - ( )
curly brace - { }	vertical bar - | |
floor - ⌊ ⌋	ceiling - ⌈ ⌉
angle brackets - < >	space (not found as an icon)

To activate a group, click on the icon of the group desired. This pushes one level onto the stack. Then type the character sequence that makes up the body of the group. Use normal MacΣqn formatting and cursor control to format the group as desired. RETURN can be used to move the cursor back to the starting position and down one line. Once you have entered all the characters (which may, of course, contain other MacΣqn constructs), type <ENTER>. MacΣqn will determine the appropriate size of the enclosing characters and position them correctly.

The **Programmable Group** icon behaves exactly the same as normal group icons except you have the ability to program what enclosing characters define the group. To program enclosing characters, activate the symbol palette by clicking on the icon. Hold the OPTION-key down and press the mouse button down over top of the character you want to have as the left enclosing character. Drag the character into the **Programmable Group** icon and release the button. A small version of the character will be drawn into the icon. You also program a closing character in the same way. Holding the OPTION-key down, select and drag the closing character and deposit it into the **Programmable Group** icon. You will see both the opening and closing character in the icon. Once programmed, you can use the **Programmable Group** just as you would any other group. This icon can be reprogrammed by depositing a new character from the symbol palette. The programmed characters are remembered until you next change them.

You can generate a group that is not enclosed by any characters by using the command-key equivalent ⌘-SPACE. This is useful for vertically centering blocks of text.

Open Group Icon

Clicking on the group command icons usually generates a closed group

command. If you want an open group to be generated, select the **Open Group Icon**. Once selected, it will stay highlighted until you next select it.

Uncentered Group Icon

Normally, MacΣqn will vertically center a group on the baseline. However, if the uncentered group icon has been selected, the group will not be vertically shifted. This is useful when you wish to enclose a block of text with large brackets but do not wish the baseline to shift. Once selected, it will stay highlighted until you next select it. The below left example shows a group with the default vertical centering; the example on the right shows the vertically uncentered mode.

$$1+\left[\begin{array}{c} 1 \\ 1+\dfrac{1-x}{1+x} \end{array}\right] \qquad 1+\left[\begin{array}{c} 1 \\ 1+\dfrac{1-x}{1+x} \end{array}\right]$$

If you select a group command using command-key equivalents, holding the OPTION-key down during the group request is equivalent to having the uncentered group icon selected.

Note: If you use MacΣqn with Switcher, you will find that selecting ⌘-'[' will send you to another application instead of drawing a Group. For this reason, MacΣqn will allow you to request a square-bracket open group by typing ⌘-'/', and the closed group version by typing ⌘-'?'.

Marks

A mark is a 'remembered' cursor position, i.e. you can request MacΣqn to remember one cursor position per stack entry for future reference. When MacΣqn activates, the current mark position is set to be the initialized position of the cursor. At any time, you can set the mark position to the current cursor position by typing ⌘-'n' (in Microsoft WORD use ⌘-SHIFT-'n'). Pressing RETURN will cause the cursor to move to the horizontal position of the mark, and down one line height. Typing SHIFT-RETURN will move the cursor directly to the mark position. The **Group**, **Matrix**, and **Determinant** functions automatically set a mark at the initial cursor position of the group or matrix (becoming the current mark for that stack entry) in order for RETURN to move the cursor to the correct position.

Grid

Typing a ⌘-SHIFT-'q' will toggle a grid pattern in the MacΣqn window. This grid is a series of dots positioned every 8 points horizontally and vertically. Tabs line up with every other dot.

Cursor Control

When MacΣqn is active the cursor is visible as flashing I-beam positioned at the insertion point. You can position the cursor at any location by pointing at the desired point , holding the command-key down, and clicking the mouse button. If the SHIFT-key is also held down when the mouse is clicked, the cursor will be constrained to move horizontally only; the vertical position will remain fixed. This is useful for moving left and right without leaving the baseline. If the OPTION-key is depressed rather than the SHIFT-key, the cursor movement will be constrained to the vertical direction. When the RETURN key is pressed, the cursor moves to the horizontal position of the current mark and down one line height. If the SHIFT-key is held down while RETURN is pressed, the cursor will move directly to the current mark position.

With no characters selected, pressing cursor keys will cause the insertion point to shift accordingly.

Editing

Simple editing of equations can be performed by judicious use of the backspace key.

MacΣqn will not allow you to backspace into characters belonging to functions that have been completed, i.e., that have already been 'popped' off the stack. If you do so, all characters associated with those level will be erased. For example, consider the sequence:

$$E(f_x) = \int_{-\infty}^{\infty} t(x)$$

You can backspace four times to erase the t(x). The next backspace will cause the entire integral (including the limits) to be erased.

Typing SHIFT-backspace tells MacΣqn to destroy all stack information. You may then backspace to *any* character desired. Cursor control, especially the use of marks, may be required to return to the baseline.

MacΣqn includes features you can use to shift a character sequence. You must first select the character sequence to be affected. To select characters, hold the mouse button down and drag the mouse. A box will be outlined. When you release the mouse button, characters within the box will be highlighted. This is known as sweep selection. Holding the SHIFT key down and clicking on another character will extend the selection. Double-clicking the mouse will select a word. Selected characters will be displayed as highlighted (white on black). To select a root, click the mouse in the trough part of the root symbol. To select lines, point at the line (or slightly above it) and click the mouse. Selected lines will be drawn in grey. If you click and hold the mouse button on a selected character, you can drag the selection wherever you wish. To shift selected characters one screen point at a time, use the cursor keys.

> If your Macintosh keyboard does not have cursor keys, type a ⌘-SHIFT-'k' to shift up one point; ⌘-SHIFT-'j' to shift down. Type ⌘-SHIFT-'h' and ⌘-SHIFT-'l' to shift left and right. Some users may recognize these four characters as similar to the standard cursor control characters of the Unix editor vi.

To replace a selected character sequence, simply type the new characters.

You can change the font or style of selected characters by selecting the menu entry for the desired font or style, or using command-key equivalents. You cannot change the size of a character.

MacΣqn supports simple character insertion and deletion. Click the mouse on the character where you wish to insert. Type backspace to delete characters, or type new characters and they will be inserted as you would expect. You cannot insert constructs such as integrals or roots, MacΣqn will beep at you if you try. This insertion/deletion capability does not provide full editing abilities, but it helps in making minor corrections a little easier.

> MacΣqn makes a simple attempt to adjust the positions of other characters in the equation to accommodate your insertions or deletions. MacΣqn will adjust the horizontal position (either left or right depending on whether you deleted or inserted a character) of all characters up to the first character (after the insertion point) that lies at the same horizontal position or to the left of the insertion point. This is a simple algorithm that works well for many situations, but not well for others. Use character shifting to reposition characters as desired.

Undo will undo any sequence of backspaces except those associated with

insertions and deletions as long as no character has been typed since the last backspace. This is very handy function. **Undo** should be available from the host application's **Edit** menu.

Transferring Equations to/from MacΣqn

Transferring the equation to the word processor is very easy. Simply pull down the application's **Edit** menu and select **Copy** (or type ⌘-'c') to transfer to the clipboard. If there is no selection, the entire equation is copied to the clipboard. If there is a current selection, then only that selection will be copied. Activate the word processor window and **Paste** the equation into the document. **Clear** can be used to erase the equation and start over. Some applications do not support a **Clear** selection in the **Edit** menu (such as MacWrite), so an equivalent **Clear Σquation** selection was put into the **Σqn** menu. To bring an equation back into MacΣqn for additions and editing, **Cut** or **Copy** the equation from the document and **Paste** into MacΣqn. All stack information will be lost, but character editing can be done as well as adding new terms. Pasting occurs at the current cursor position. You can also paste TEXT into MacΣqn.

When you paste a complete equation into a word processor, the equation will be automatically centered within the width you have specified in the Ruler at the top of the MacΣqn window (the ▶| slider). The equation number will be located at the position defined by the equation-number tab (the ▽ slider in the Ruler). If you select a copy by ⌘-'c' with the OPTION-key pressed, the equation will be left-indented with the indent specified in the Ruler (the ▼ slider). Selecting a copy with the SHIFT-key depressed, i.e., ⌘-SHIFT-'c', will copy the equation to the clipboard with no indent and with no effort at positioning the equation number at the tab position. If you copied a selection rather than the entire equation, the copied characters will not be auto-centered or left-indented.

MacΣqn Eccentricities

- When shifting root symbols and large brackets, a trail of dots may be left on the screen. Use **Refresh** to erase this artifact.

- Outlined characters do not erase correctly. A non-outlined version of the character will be left visible on the screen after

the backspace. A **Refresh** will erase this artifact.

- Use the version of Font/DA Mover supplied on the distribution disk, or a later one, to copy MacΣqn to your system. Do not use earlier versions.

- In general, pasting into the middle of an existing equation is a bit flakey.

Appendix

General Information

MacΣqn has built into it storage currently capable of handling equations with up to 384 characters and 16 nested 'levels of function'. A level of function is any mathematical construct requiring special formatting to be displayed correctly. Subscripts and superscripts are examples of such constructs.

Equations are drawn using Macintosh Quickdraw calls and are stored in the clipboard using the standard picture (PICT) format. A picture is a *collection* of the Quickdraw calls necessary to draw the image on the screen. It is important to note the picture is not the resulting graphical image but the calls required to create the image, i.e. a description of the equation in Quickdraw language. By storing information in this manner (a description rather than the graphical image), the equation can be printed to the maximum resolution of the printing device used. If the printing device is a LaserWriter, resolution of 300 dots per inch can be achieved even though the screen image is only 72 dots per inch.

When using a word processor it is generally good practice to save your files after every few paragraphs have been typed. This is also a good thing to do when using MacΣqn; you should save your document after every few equations are pasted in. This minimizes loss of information if your computer crashes.

MacΣqn is a 'stack-based graphics editor.' Each time a request is made to perform some special formatting (such as a request for a subscript and superscript), the command is pushed onto a stack. Most commands supported by MacΣqn actually push two functions onto the stack. For example, when a summation is requested the summation symbol is drawn and a request for an upper limit is pushed onto the stack, followed by a request for a lower limit. Since the lower limit was pushed last, it becomes the current level and the cursor is positioned ready to accept input for the lower limit. Pressing the <ENTER> key notifies MacΣqn that input to the level has terminated and the function may be popped off the stack. Any scaling or repositioning of data is then performed and the screen is redrawn. The cursor is moved to the appropriate position for the new current level (whatever was next in line

after the last stack entry was popped off). The Stack status line indicator found at the top of the MacΣqn window tells the user what command is associated with the current stack entry, what the current level is, and depth of the stack.

Information pushed onto the stack with each command includes font, font size, font face, cursor position, etc. When a level is popped off the stack, this information is used to set the font characteristics as they were before the command was pushed onto the stack. For example, if the current font was a 12 point Helvetica when an integral was requested, the current font and size would be reset to 12 point Helvetica when the integral limits were completed.

Since there is a defined limit to the number of characters available to MacΣqn (currently 384) a space-conserving technique is provided. During normal operation when space bar (or TAB key) is struck a true space (or TAB) character is stored into the data array. However, holding the SHIFT key down while typing space or TAB will cause the cursor to move the correct distance but no character will be stored into the data array. If the equation is complex you can make use of this feature to conserve space. It is important to note that since SHIFT-spaces and SHIFT-tabs are not stored in the data array, backspace will jump over them and erase the previous real character.

Helpful Hints

Comments on character centering

A character in a Macintosh font is bounded by a rectangle that has a width returned by the ROM call CharWidth. MacΣqn uses this value in its automatic centering algorithms. However, in many instances, Macintosh fonts do not center characters in this rectangle but have the character shifted slightly to one side or another. This can result in MacΣqn positioning a character on screen slightly to one side or another of what would be expected. This is particularly noticeable when you request a **Centered Super/Subscript.** Of LaserWriter fonts, Helvetica seems to be best at having well-centered characters.

Hatting (^) a character (Two ways to do it)

- If the character is a vowel, type OPTION-i followed by the vowel: ê
- Type the character, then click on the [x̂] icon: ê

Limit as n goes to infinity

- Click on the [x] icon to activate a body-centered super/subscript.
- Type 'lim' followed by <ENTER>.
- Type 'n→∞' as the subscript, followed by <ENTER>.
- Type <ENTER> to terminate the (non-existent) superscript: $\lim_{n\to\infty}$

Limits on multiple integrals

For a multiple integrals with a single set of limits, again use the body-centered super/subscript command. For a triple integral:

- Click on the [x] icon to activate a body-centered super/subscript.
- Click on the [∫] icon followed by <ENTER> <ENTER> (press <ENTER> twice).
- Click on the [∫] icon again, followed by <ENTER> <ENTER>

- Click on the [∫] icon once again, followed by <ENTER> <ENTER>
- Press <ENTER> to terminate the body (the three integrals).
- Type '-∞' as the subscript, followed by <ENTER>.
- Type '∞' as the superscript, followed by <ENTER>: $\int\!\!\int\!\!\int$

Inline Equations

MacΣqn has always supported inline equations; however, not all word processors will allow you to insert an equation into a line of text. For example, MacWrite and Microsoft Word 1.05 do not allow you to inset equations inline, but Word 3.01, WriteNow, and most other later word processors do. When you create an equation for inline insertion, use the **Copy as Inline** menu selection to copy it to the clipboard. In your document, select the position you wish the equation to be inserted, and select **Paste**. The equation will be inserted. You may find the equation seems to sit too high on the baseline. Most word processors that support inline insertion of pictures will place it such that the bottom of the picture corresponds to the text baseline. To shift the picture down to its proper position, request the word processor to subscript it the appropriate number of points. For example, x_1^{2n} is a simple equation pasted into this line of text. Notice the how the equation sits much too high on the baseline. Subscripting this equation by 6 points results in x_1^{2n}. Also, notice in the first insertion how the text lines separated. The word processor forced the lines to separate so adjacent lines would not overlap. To minimize line separations (called line leading), set **Vert Border** in the **Preferences...** dialog to 0 or 1. Larger values will increase the space between lines (called line leading).

Style

Since the editing abilities of MacΣqn are limited, it is good practice to put the equation you wish to write on paper before typing into MacΣqn. This way you have a good feeling of how the equation is formed and how it should be input to MacΣqn. This saves typing time in that fewer errors will be made and less editing will be required.

Bug in interacting with Microsoft Word

We have found an annoying problem in the communications between MacΣqn and Microsoft Word 1.05. This problem does not exist with Word 3.0. When you use ⌘-'c' to copy an equation from MacΣqn to the clipboard, the equation will appear as desired when pasted it into Microsoft Word 1.05. However, if you copy the equation to the clipboard using one of the optional forms (⌘-OPTION-'c' or SHIFT-⌘-'c'), the equation will not paste into Word correctly. Apparently, Word does not realize the system clipboard has changed when using the optional forms of copy and does not load the system clipboard into its own internal clipboard. Thus, if you try to do a left-justified copy, nothing will paste into the Word document (or the previous contents of the clipboard will be pasted.) There is a simple work-around to this problem. If you wish to select one of the optional forms of copy, type ⌘-'c' first, followed immediately by the optional copy command you want. The first ⌘-'c' notifies Word the contents of the clipboard have changed; the second copy puts the desired info into the clipboard. All will be well if you use this approach.

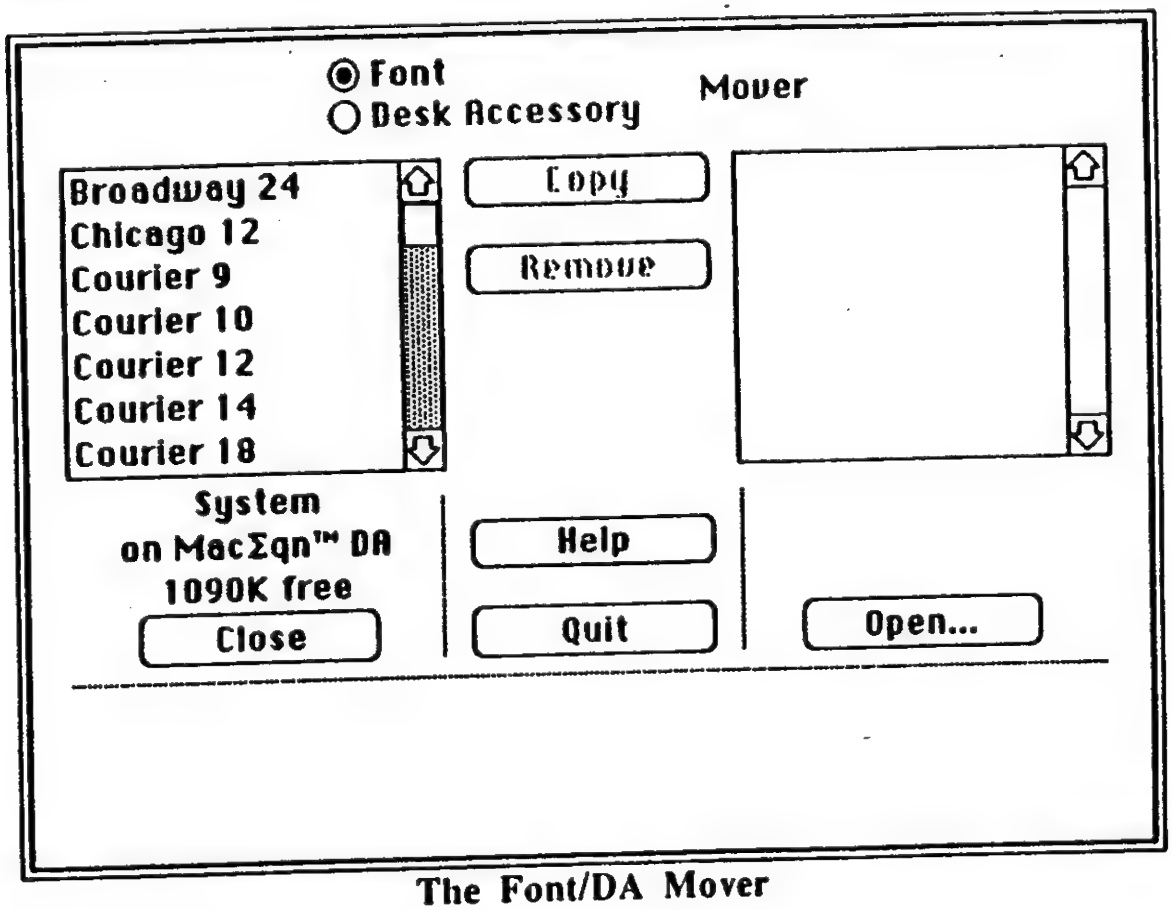
Installing a Desk Accessory

The MacΣqn Desk Accessory needs to be installed in the system file before it can be used. This is accomplished with the *Font/DA Mover* supplied on the distribution disk. First, place a copy of the *Font/DA Mover* and the file MacΣqnDA,

, in the folder containing the System and Finder. (Note: copying these files to the system folder is not required, see below.)

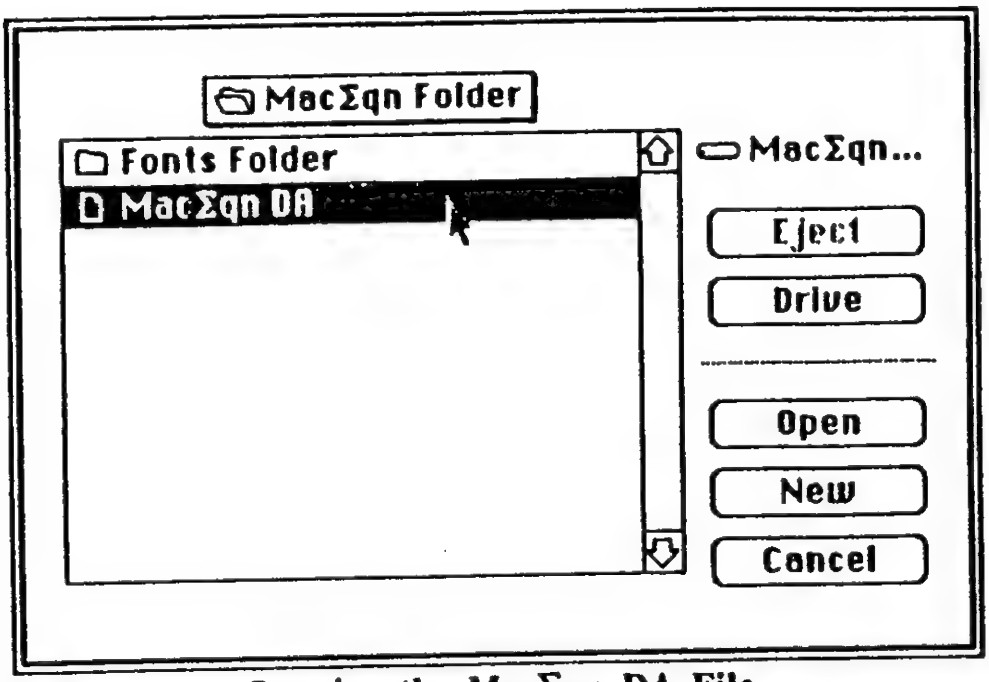
Now double-click the Font/DA Mover icon,

. A window similar to the one below will appear.



The Font/DA Mover

The list of names on the left are the fonts that are currently installed into your operating system. Click the radio button labeled ◉ **Desk Accessory**. In a short time, the list of font names will be replaced by a list of currently installed desk accessories. Click **Open...** in the lower-right corner of the window. The dialog box similar to below will appear.



Opening the MacΣqn DA File

Double-click the MacΣqn DA. The *Font/DA Mover* dialog box shown in the figure above will reappear with "**MacΣqn**" listed in the scrollable window on the right.

Click "**MacΣqn**" in the window. Now click the button [<< Copy <<] in the dialog box. This will cause the MacΣqn to be installed into the operating system.

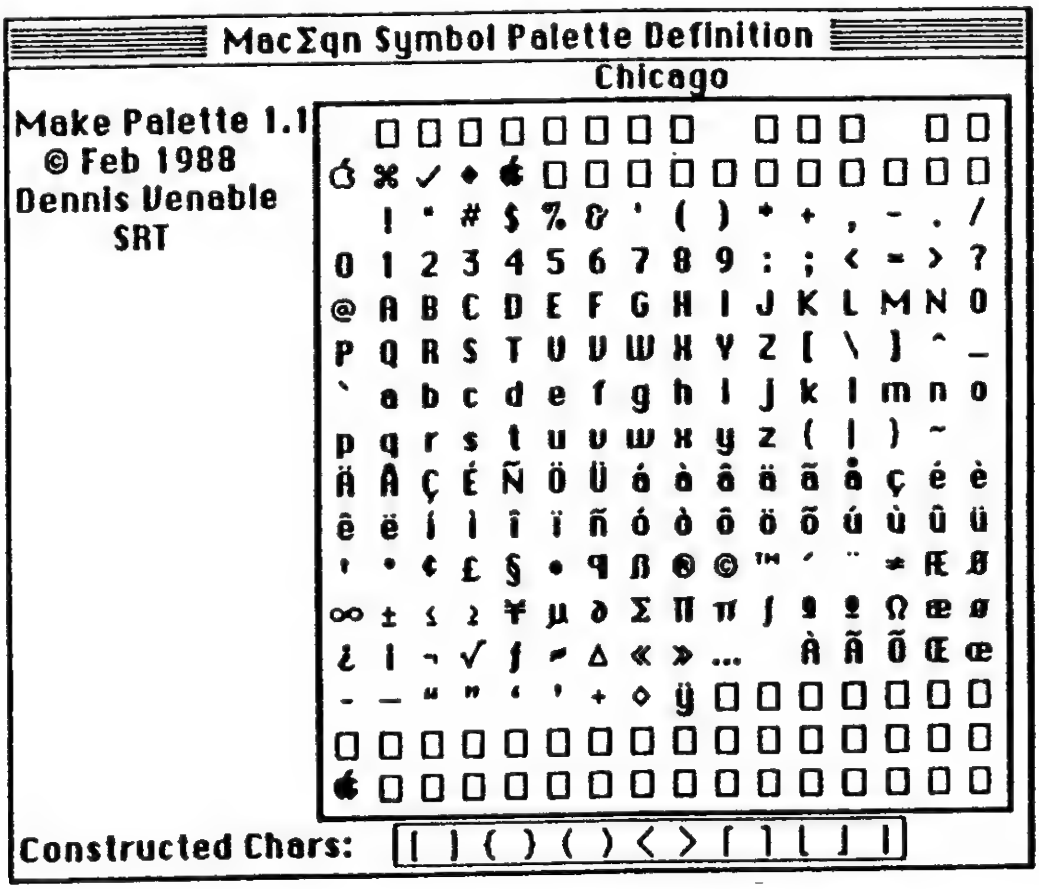
Finally, click [Quit] to quit the program *Font/DA Mover*. You will need to repeat this process for any system disk that will be used with this desk accessory.

The process for installing fonts is the same as for desk accessories, except that you do not click the ◉ **Desk Accessory** button.

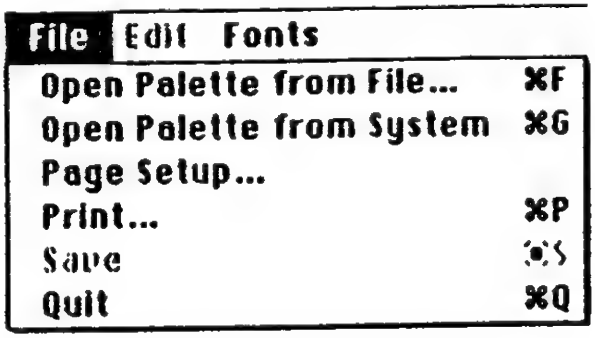
- It is not required that you copy *Font/DA Mover* and MacΣqnDA to the System Folder. You can use the [Drive] and [Eject] buttons to open files on different disks and drives. This will allow you to install fonts and MacΣqn onto your system directly from the distribution disk.

Programming the Symbol Palette

One of the nicest features of MacΣqn is the ability to customize the symbol palette to contain your own favorite set of special characters. Symbol palettes are stored as resources within the MacΣqn. *Make Palette* is an editor for this resource. When you run *Make Palette* by double-clicking on its icon, the window pictured below will appear on the screen. The box on the right is a map of all characters available in the current font (by default, Chicago). You choose a different font by making a selection from the **Font** menu.



You must tell the program where to find the symbol palette resource you wish to edit. Under the **File** menu, you have two choices:



- **Open Palette from File...**

  Choosing **Open File...** will bring up a standard file dialog listing desk accessory files. You then choose which copy of the disk file MacΣqnDA you wish to edit. You can use the **Drive** and **Eject** buttons to edit palettes on different disks.

- **Open Palette from System**

  Choosing **Open System** will look for the symbol palette in a copy of MacΣqn already installed into your operating system. If *Make Palette* cannot find the resource in the system file, it notifies you with a dialog box.

Once the palette has been found, is is loaded into the *Make Palette* window and displayed exactly as it appears in MacΣqn.

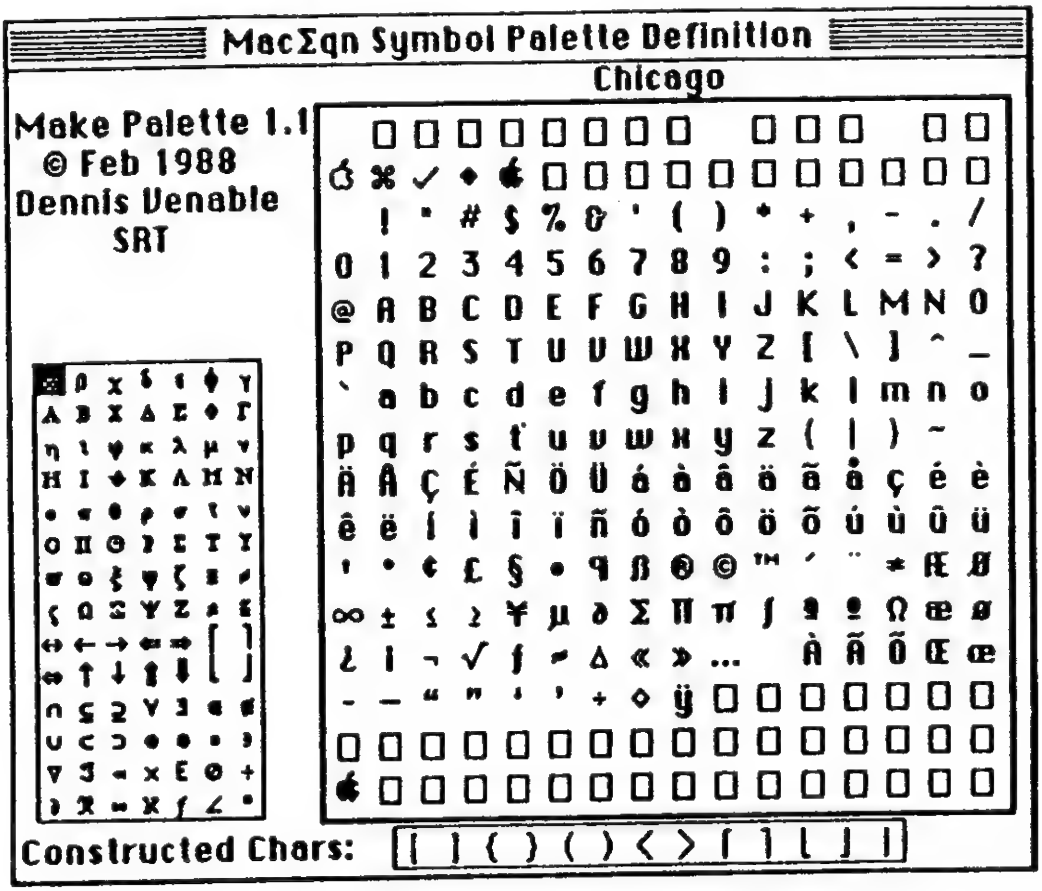
To program the palette, simply point at the character in the font box you want in your palette and click the mouse. This character will replace the highlighted character in the symbol palette, and the highlight will advance to the right. You may specify which character is highlighted in the symbol palette by clicking on the desired character. You may change fonts at any time.

Make Palette will not allow you to select characters from the first two rows of the font map. These are usually non-printing characters and MacΣqn uses the codes for special purposes. However, you can select the ⌘ ✓ ◆ characters from **Chicago** font.

Along the bottom of the *Make Palette* window is a set of special characters marked **Constructed Chars.** Many customers have requested that large brackets, braces, etc., be made available for their equations outside of the standard group or matrix context. If a normal bracket or brace character is used, it gets very fat (or boldy) when scaled large; this is not acceptable. The group and matrix functions build large brackets from character segments found in the Symbol font. You can now place these special constructed characters into your palette by selecting them from the **Constructed Chars** icons found below the normal font matrix. Below is an example of a customized group function using standard characters and using the special constructed characters:

Regular Chars: $\left\{\begin{matrix} ab \\ cd \\ ef \\ gh \\ ij \end{matrix}\right]$ Constructed Chars: $\left[\begin{matrix} ab \\ cd \\ ef \\ gh \\ ij \end{matrix}\right\}$

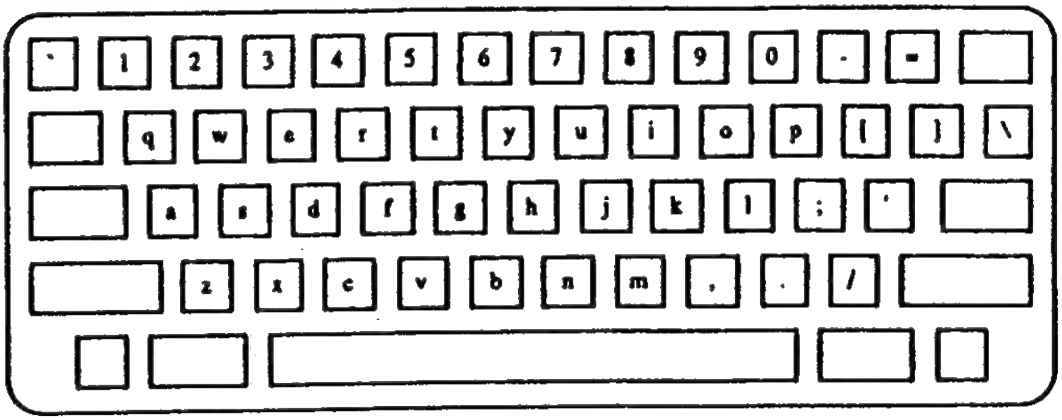
Make Palette will also allow you to print the font matrix. After choosing the font of interest, you can select **Print** from the **File** menu to print the fonts. *Make Palette* provides an exceptionally easy way to get a hardcopy of all characters available in a given font.



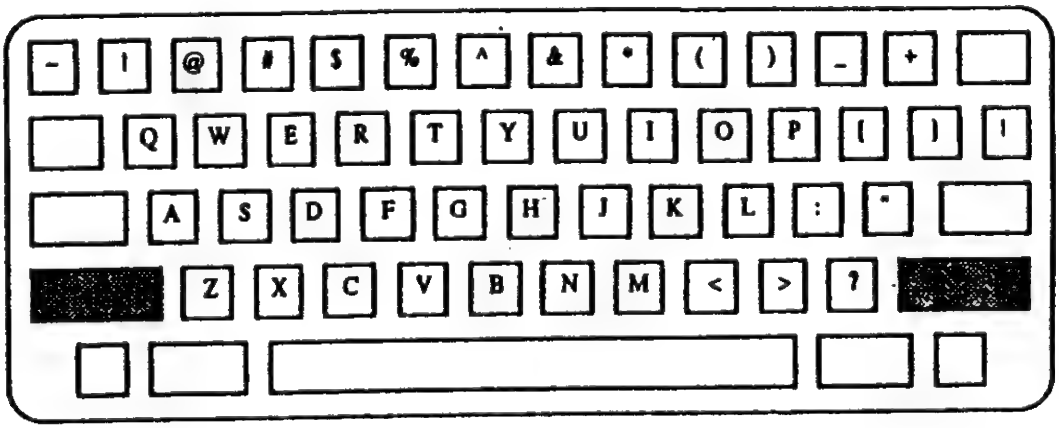
**** IMPORTANT ****

When you have completed defining your palette, you must explicitly save the palette by selecting **Save** from the **File** menu. *Make Palette* does not automatically save the palette on exiting, though it will verify if you really want to quit without saving your changes.

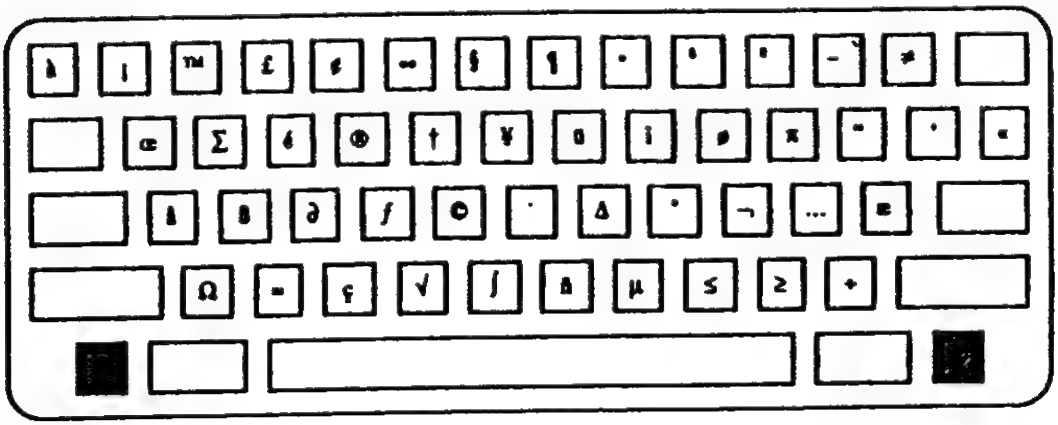
Times Keyboard Mapping



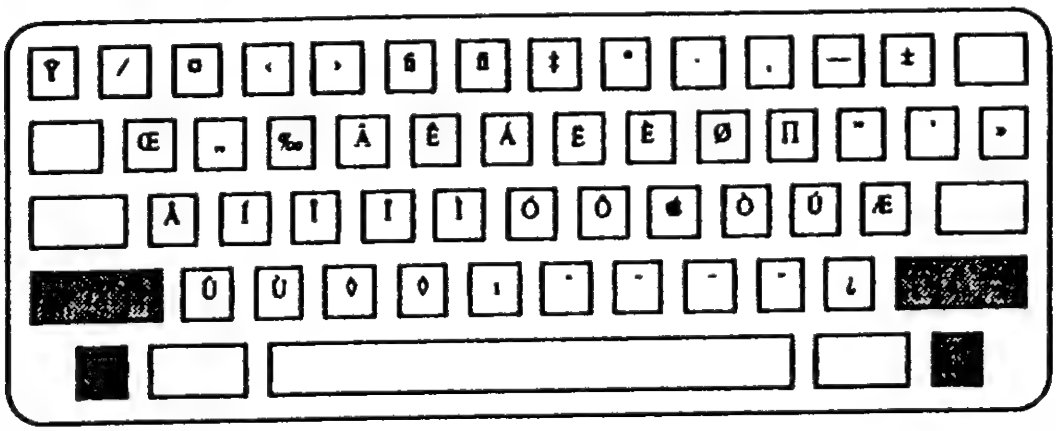
Shifted Characters



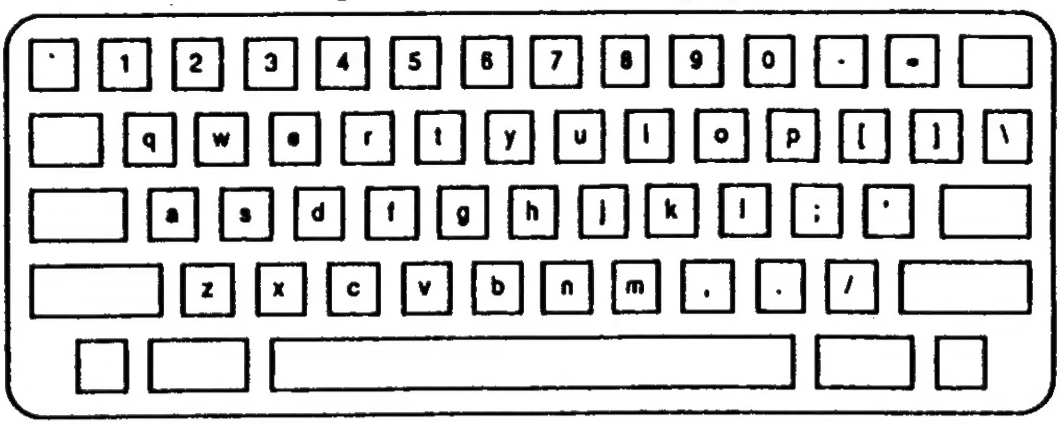
Option Characters



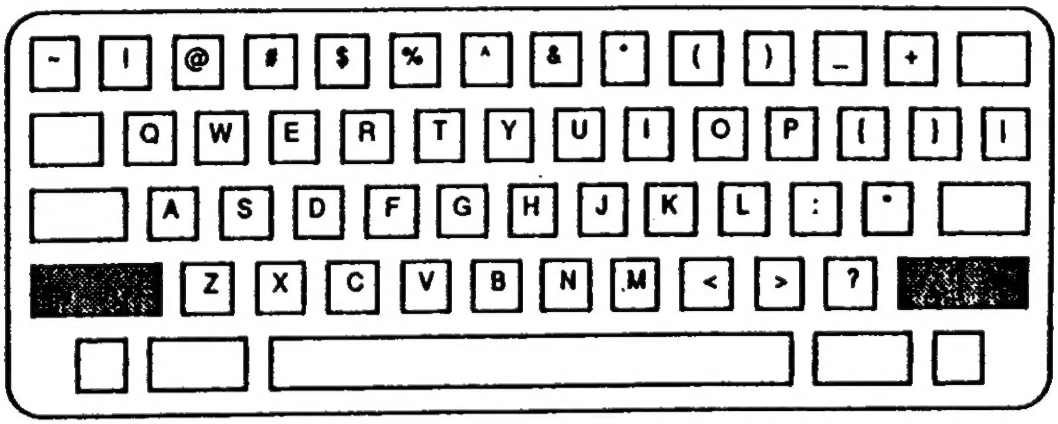
Option - Shift Characters



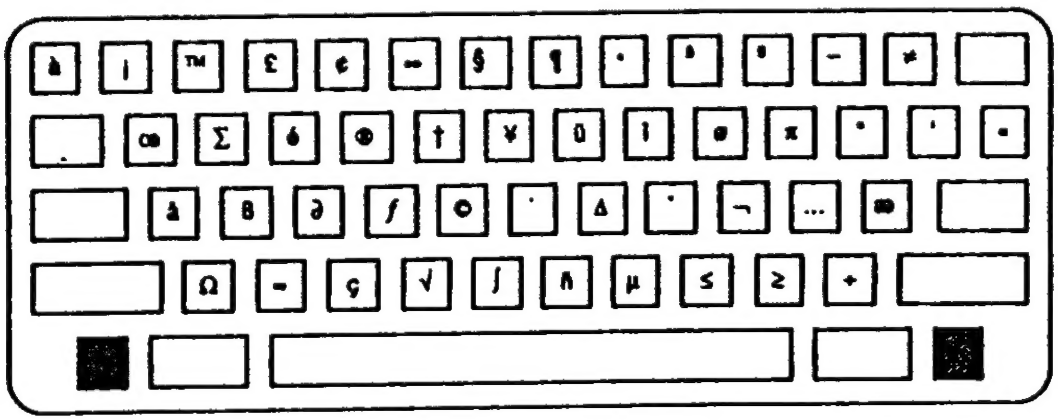
Helvetica Keyboard Mapping



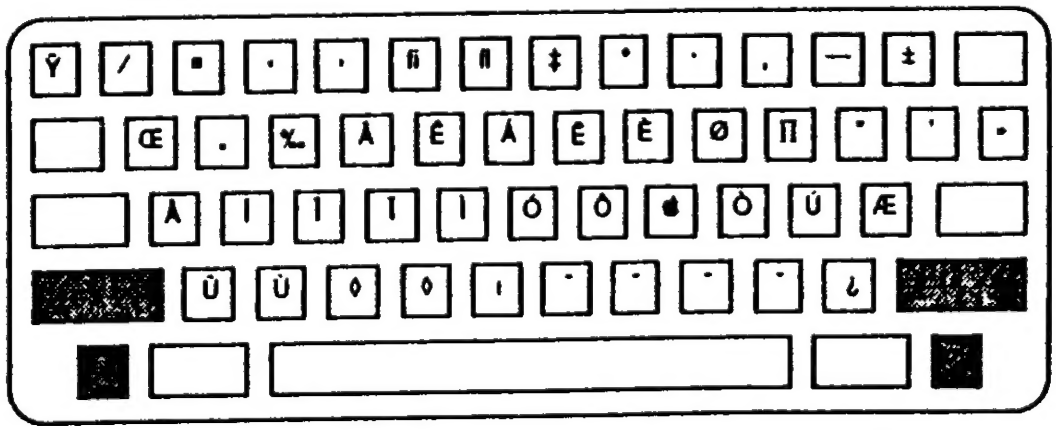
Shifted Characters



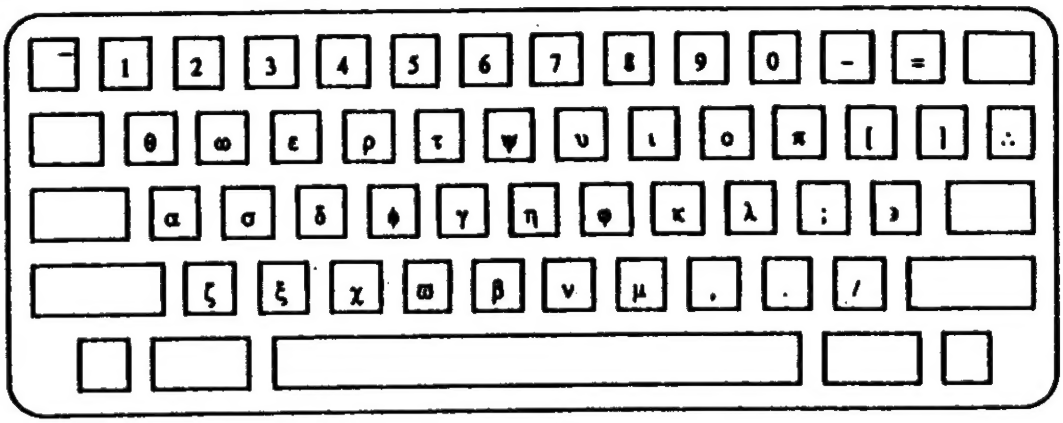
Option Characters



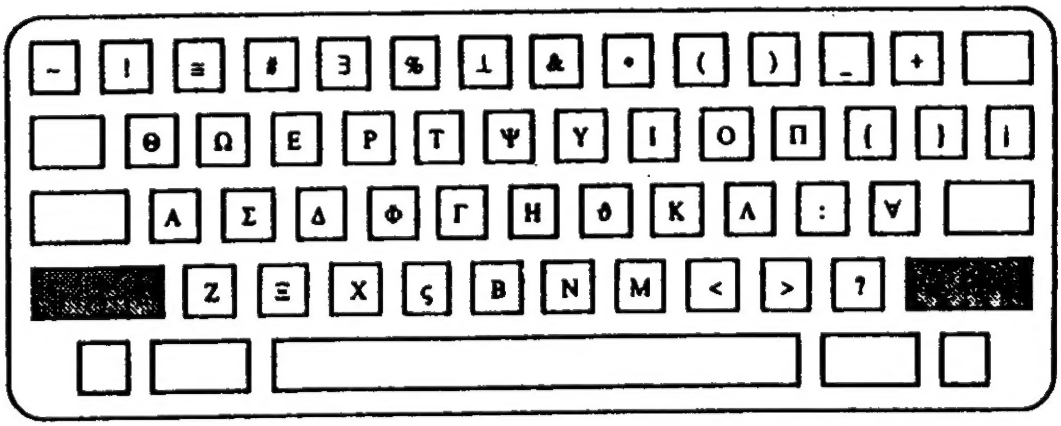
Option - Shift Characters



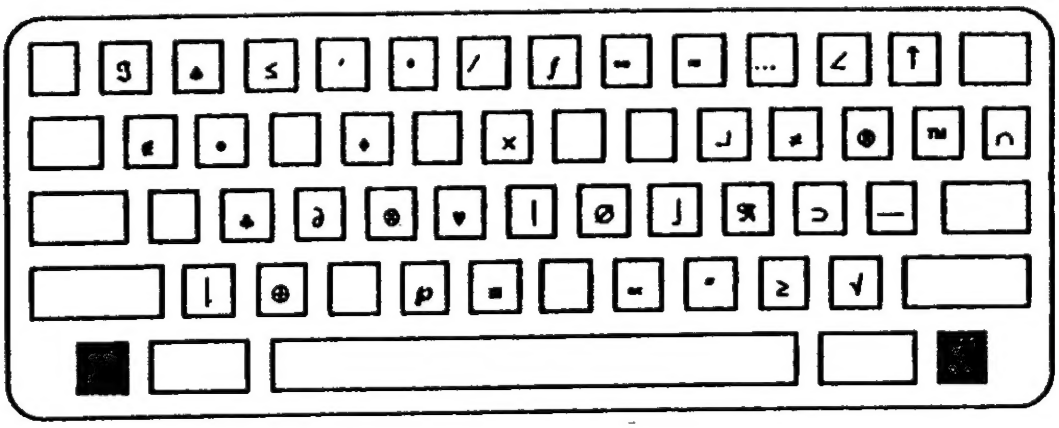
Symbol Keyboard Mapping



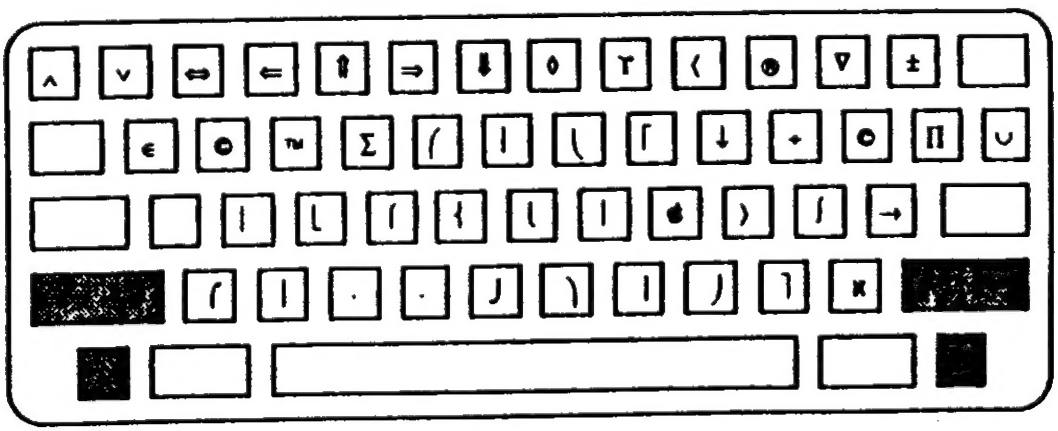
Shifted Characters



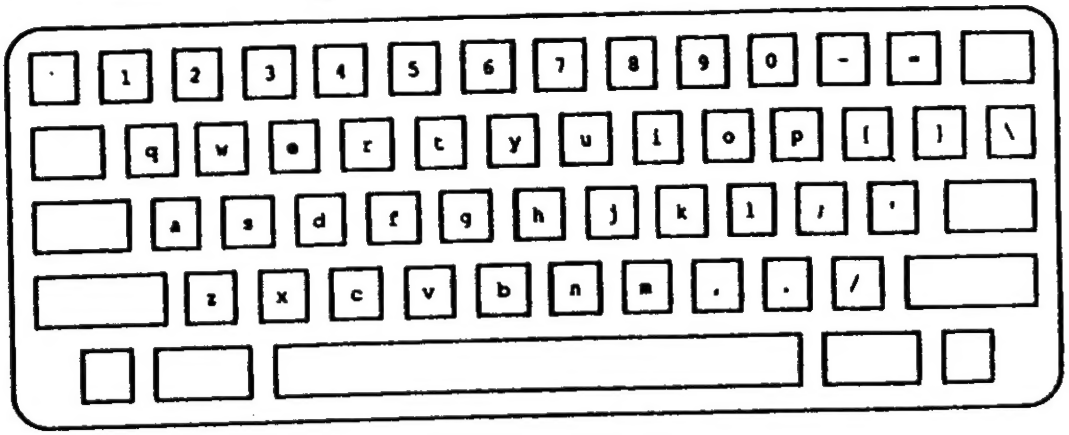
Option Characters



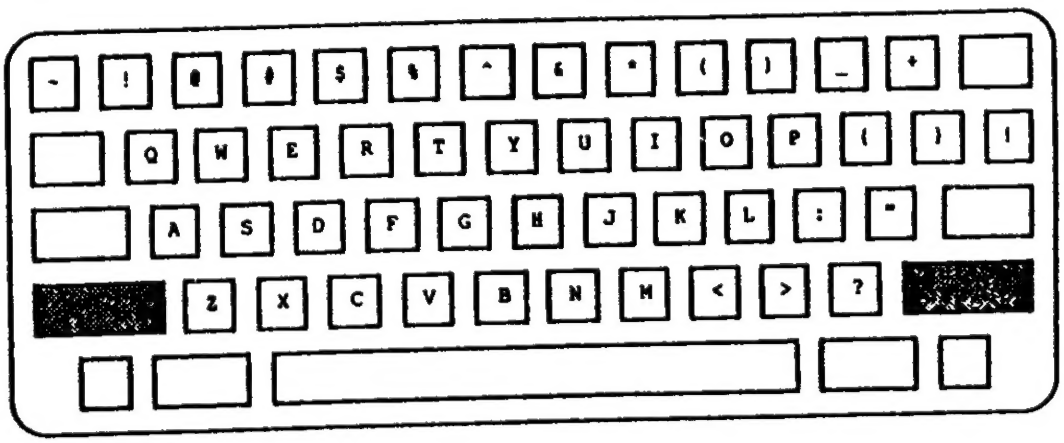
Option - Shift Characters



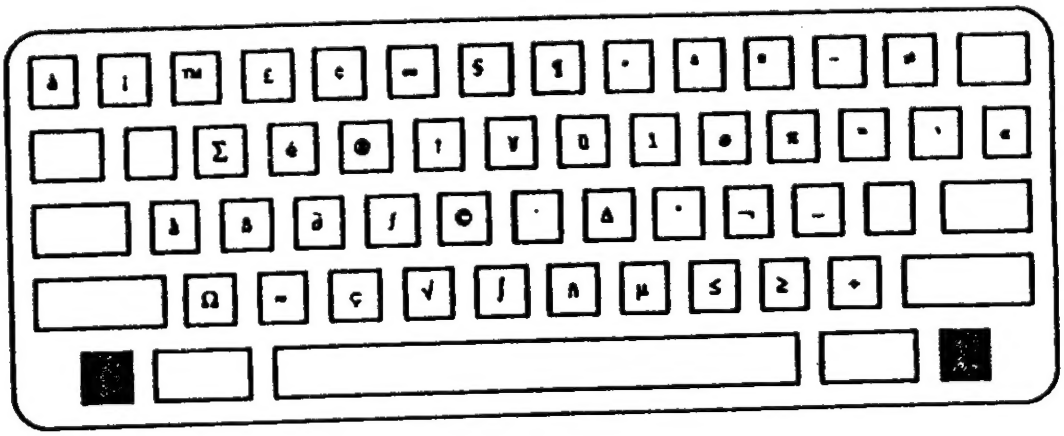
Courier Keyboard Mapping



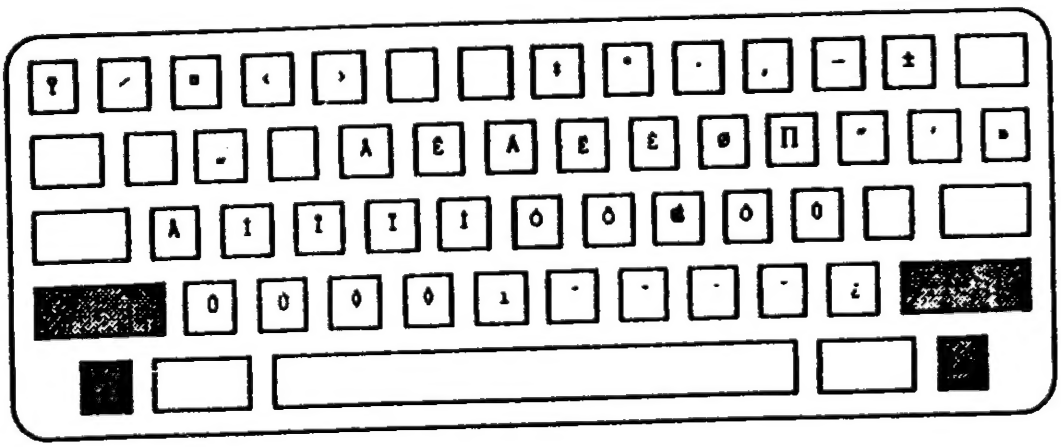
Shifted Characters



Option Characters



Option - Shift Characters



MacΣqn Command Key Equivalents

Font Group:

⌘-H	Helvetica font	⌘-B	**Bold face**
⌘-T	Times font	⌘-L	*Italics face*
⌘-G	Σψμβολ φοντ (Symbol)	⌘-U	<u>Underline face</u>
⌘-Y	Courier font	⌘-E	Outline face
⌘-A	Other fonts		
⌘-.	Increase font size	⌘-,	Decrease font size

Function Group:

Option - ⌘-I	Smaller Integral	Option - ⌘-S	Smaller Sum
⌘-I	Integral	⌘-S	Summation
Shift - ⌘-I	Bigger Integral	Shift - ⌘-S	Bigger Sum
Option - Shift - ⌘-I	Biggest Integral	Option - Shift - ⌘-S	Biggest Sum
Option - ⌘-P	Smaller Product	⌘-F	Fraction
⌘-P	Product	Shift - ⌘-F	Fraction, reduction
Shift - ⌘-P	Bigger Product	⌘-M	Matrix
Option - Shift - ⌘-P	Biggest Product	Option - ⌘-M	Determinant
⌘-O	Overbar	⌘-R	Root
Option - ⌘-O	Over-arrow	⌘-D	Refresh display
⌘-[	Open group [bracket]	⌘-]	Closed group [bracket]
Shift - ⌘-[	Open group {brace}	Shift - ⌘-]	Closed group {brace}
⌘-\	Open group |bar|	Shift - ⌘-\	Closed group |bar|
⌘-;	Open group (paren)	Shift - ⌘-;	Closed group (paren)
Shift - ⌘-,	Open group <angle brk>	Shift - ⌘-.	Closed group <angle brk>
⌘-SPACE	Group (no open/close char)	Option - Group Request	Uncentered group

⌘--	Superscript - Subscript
⌘-=	Superscript - Subscript centered on last character
Option - ⌘-=	Superscript - Subscript centered on current position
Shift - ⌘-=	Superscript - Subscript centered on last character, superscript is dropped down

Cursor Control:

⌘-Mouse click	Set new cursor position
Shift - ⌘-click	Set new cursor position, horizontal variation only
Option - ⌘-click	Set new cursor position, vertical variation only
SPACE	Store space character
Shift - SPACE	Move cursor width of space, no data storage
TAB	Store tab character
Shift - TAB	Move cursor width of tab, no data storage
⌘-TAB	Move cursor to Equation Number position
RETURN	Move cursor to current mark position and down one line
Shift - RETURN	Move cursor to current mark position
⌘-N	Set current mark position (shift in MSWord)
Shift - ⌘-q	Toggle grid pattern

Editing:

⌘-C	Copy to clipboard (cntrd)	Option - ⌘-C	Copy with left indent
Option - Shift - ⌘-C	Copy to clipboard	⌘-V	Paste from clipboard
⌘-Z	Undo BACKSPACE sequence	ENTER	Pop the current level
Mouse click	Select character	Double - click	Select word
Shift - click	Extend selection	Option - click	Set insertion/deletion point
Shift - BACKSPACE	Clear stack	BACKSPACE	Remove last character
Shift - ⌘-'h', 'j', 'k', 'l'	Shift selctn left, down, up, right	←,↓,↑,→	Same as Shift - ⌘-'h', 'j', 'k', 'l'